PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Motor Vehicle Window Regulators

We, FORD MOTOR COMPANY LIMITED, of 88, Regent Street, London, W.1, England, a Company incorporated under the Laws of Great Britain, do hereby declare the invention (a communication to us from abroad by Ford Motor Company, of Dearborn, Michigan, United States of America, a Company organised under the Laws of the State of Delaware, United States of America), for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates generally to window operating and guiding means for motor vehicles, and has particular reference to mechanism adapted to control the movement of a power operated vehicle window in a predetermined direction.

A contemporary trend in motor vehicle body design places emphasis on increasing the glass area above the belt line. This trend has been evidenced by the elimination or the reduction to an absolute minimum size of the conventional body pillars above the belt line. It is expected that the next major body design evolution, one that is at present in its preliminary stages of introduction, will be the universal adoption of curved window glass in the side panels of the vehicle body, following the pattern set by the adoption of curved or wrap-around windshields and rear windows. Yet, it is still required that the side windows be mounted within the body shell so that they may be raised and lowered as desired.

It is an object of the present invention to provide a mechanism for supporting and operating a window panel which is adapted to overcome any of the limitations which may be imposed by the vehicle body design conditions. The invention consists in a window structure for a vehicle body having a window frame with a window opening and a well therebelow, comprising a window panel adapted to be raised and lowered between said window opening and said well, a motor support means secured to said panel at the lower edge thereof, reversible motor means carried on said support means, fixed guide means in said well controlling the path of movement of said panel, said guide means comprising at least one elongated guide track, and connecting means drivingly connecting said motor means to said guide track for moving said panel into and out of said opening.

The feature of the present invention in which the motor means is mounted on a common support structure with the panel so that the two are movable as a unit provides a construction and arrangement adaptable to flat or curved panels movable in a direct vertical path into or out of a window well, to flat or curved panels mounted for swinging movement about a fixed pivot into or out of a window well, and to flat or curved panels which must be moved into or out of a vehicle window well in a movement pattern which may involve combined longitudinal and vertical movements.

The invention will be further described in connection with the accompanying drawings, wherein:

Figure 1*a* is a perspective view of a vehicle window panel and window operating mechanism incorporating one embodiment of the present invention;

Figures 1*b*, 1*c* and 1*d* are diagrammatic views showing the position of the window panel in raised, intermediate and lowered positions;

Figure 2 is a section taken along line 2—2 of figure 1*a*,

Figure 3 is a perspective view in part similar to figure 1*a* illustrating a second embodiment of the present invention; and

Figure 4, 5, 6 and 7 are side elevational views illustrating further embodiments of the present invention.

Referring now to the embodiment of the invention illustrated in figures 1*a*, *b*, *c*, and *d*, and 2, there is shown in figure 1*a* a fragment-

[*Price 3s. 6d.*]

ary portion of a motor vehicle transparent panel or window glass 11 encompassed by a frame 12. A lower horizontal rail portion 13 of the frame 12 is provided at each end thereof with depending leg portions 14 and 16. Extending longitudinally beneath the frame 12, and preferably integral therewith, is an inverted T-shaped track or rail 17 from which is slidably suspended a reversible electric motor and reduction gear unit, generally designated 18.

The forward depending leg portion 14 is provided with a roller 19 slidably received within a generally vertically extending guideway or guide track 21. Similarly, the rear depending leg portion 16 is provided with a roller 19 slidably received within a second generally vertically extending guideway or guide track 22. Both guideways or guide tracks are of similar generally channel-shaped cross section and are mounted in a suitable manner on the vehicle body within the window well, beneath the window opening.

The guideway or guide track 21 is provided with an upper portion 23 inclined toward a horizontal position, the remaining portion 24 thereof being substantially straight but tilted slightly from a true vertical position. The rear guideway or guide track 22 has an upper portion 26, also substantially straight, with the longitudinal axis thereof substantially parallel with the longitudinal axis of the lower portion 24 of the guideway or guide track 21. A lower portion 27 of the guideway 22 is turned rearwardly toward a horizontal position.

Interposed between the forward guideway or guide track 22 is a third, channel shaped, guideway or guide track 28. It extends in a substantially vertical direction but is uniformly curved from the top toward the bottom in a forwardly extending direction, and is secured to the vehicle body similarly to the outer two guideways or guide tracks. In addition, the guideway or guide track 28 is provided along a forward flange 29 of the channel opening therein with a plate 31 (see also figure 2) provided with rack teeth 32 engageable by a pinion 33 keyed to the shaft 34 of a reduction gear assembly 36 of the motor and gear unit 18.

It will be noted that the plate 31 is secured to the inner side of the flange 29. The opposite or rear flange 37 is parallel thereto but is spaced outwardly of the flange 29 and is adapted to be interposed between the pinion 33 and the housing of the reduction gear 36. The pinion 33 is provided with a roller or groove portion 38 adapted to bear against a rolled edge 39 of the flange 37.

Referring now to figures 1*b* *c* and *d*, the movement pattern of the window panel 11 may be explained as follows: Since the forward end 41 of the window panel overlies the body pillar, represented by the line 42, the movement must be such that the window panel is moved rearwardly before it is dropped into the window well.

Upon rotation of the pinion 33 in a clockwise direction as viewed in figure 1*b*, the rear end 43 of the window will move downwardly relatively to the vertical portion 26 of the guide track 22. The forward end 41 of the window will momentarily dwell relative to the upper end 23 of the guide track 21. As the rear end 43 of the panel continues its vertical descent, the front end 41 will begin to move rearwardly and slightly downwardly along the upper end 23 of the guide track 21. In the meanwhile, the pinion 33 will be travelling downwardly along the rack teeth 32.

When the position shown in figure 1*c* is reached, which might be considered the centre or midpoint position, there is a substantial reversal of the relative rate of downward movement of the two ends of the window panel. The forward end 41 is now in the approach to the substantially straight portion 24 of the guide track 21 and the rear end 43 is in the approach to the curved portion 27 of the guide track 22. Thus, the forward end 41 of the window panel begins to descend rapidly while the rear end 42 reached a position in which it continues to move only slightly rearwardly and downwardly.

Between the figure 1*c* position and the final figure 1*d* position the forward end 41 of the window is dropped below the level of its rear end 43. The curved line 44 represents the vehicle body wheel housing. It is because of this wheel housing that it is necessary to limit the downward movement of the rear end 43 of the window panel.

It will be noted that as the window travelled downwardly, the position of the motor and gear unit 18 changed relatively to the window panel. As was described, the motor and gear unit 18 is slidable on the track 17. The curvature of the guide track 28 is such that the motor is caused to move to that side of the vertical centreline of the window panel corresponding to the end of the panel which is to be lifted most rapidly. For example, referring to figures 1*d*, 1*c* and 1*b*, in that order, it will be noted that at the start of the raising action, the motor and gear unit 18 is located near the forward end 41 of the window panel. As the window is raised it is this end of the window which requires the most lift effort since the connection between the end 43 of the panel and the track portion 27 acts as a fulcrum about which the panel is pivoted in its initial stages of upward movement.

In the figure 1*c* position, there is a momentary lull in the lifting action and the motor and gear unit 18 is positioned so that the line of action or contact point between the pinion 33 and rack 32 lies substantially on the vertical centre line of the panel 11. Beyond the figure 1*c* position, the pivot fulcrum shifts to the connection between the forward end 41

of the panel and the upper portion 23 of the guide track 21. Now, most of the lifting action takes place on the rear end 43 of the window panel and the motor and gear unit 18, accordingly, is now positioned nearest to this end of the panel.

The embodiment of the present invention illustrated in figure 3 is similar in many respects to the previously described embodiment. The window panel 11 is encompassed by a frame 46 having a lower rail portion 47. The lower rail portion is provided with depending leg portions 48 and 49 adapted to be coupled by rollers 51 to guide tracks 52 and 53. The guide tracks 52 and 53 are substantially similar to the previously described guide tracks 21 and 22.

In the present embodiment a track member 54, supporting the motor and gear unit 56, and the guide track 57, operatively associated with the motor unit, are more complicated, for reasons to be explained. The track member 54, corresponding in function to the previously described track member or rail 17, comprises a channel-shaped member which may be formed integral with the lower rail 47. The track member 54 is formed with an upper downwardly extending rail 58 which is co-operatively opposed by a lower upwardly extending rail 59. It will be noted that the rear end 61 of the track member 54 is substantially horizontal. The centre section 62 curves away from the frame lower rail 47 and terminates in a forward section 63 which is in horizontally spaced relationship with the frame lower rail.

The motor and gear unit 56 is supported on a bracket or flanged member 64. The main or vertical plate 66 of the bracket 64 extends vertically and is provided at its upper edge with a pair of horizontally spaced grooved rollers 67 adapted to engage the rail 58. Near the lower left hand corner thereof, the plate 66 is provided with a slide member 68 adapted to hook over the lower rail 59.

The motor 69 of the motor and gear unit 56 is suspended from beneath a flange portion 71 of the bracket 64, the motor shaft 72 and coupling 73 extending upwardly between the rail 59 and bracket plate 66. The coupling 73 couples the motor shaft to the reduction gear unit, of which only a portion of the housing 74 is shown. A pinion 76 is on a shaft (not shown) which projects through the plate 66. The drawing is shown as a cut-away view at this portion since the pinion 76 would normally not be visible when viewed as in figure 3.

The guide track 57 is substantially channel shaped and is provided at the front face thereof with a rack plate 77 having the rack teeth 78 thereon adapted to be engaged by the pinion 76. The guide track 57 is more sinuous than the guide track 28 of the previous embodiment in that it has a substantially vertical lower portion 79 curving into a substantially horizontal centre portion 81 terminating in a substantially vertical upper portion 82.

The movement pattern of the window panel is substantially the same as that shown in figures 1*b*, 1*c* and 1*d*.

The effect of the coaction between the curved track 54 and the sinuous guide track 57 is twofold. First, the two track curvatures are so related that a substantially uniform motion is achieved as the window is tilted fore and aft as it is raised or lowered. In the previously described embodiment, the movement appears at times to be slightly irregular or jerky. Second, the gradually inclined centre portion 81 of the guide track 57 prevents any appreciable loss of mechanical advantage as the pivot fulcrum of the window panel is shifted from one end to the other. With regard to figure 1*c*, it will be noted that in the previous embodiment substantially the whole weight of the panel and the motor unit is on the intermeshed pinion and rack teeth at this point. In the present embodiment the guide track centre portion 81 supports the dead weight of the panel and motor unit during the transfer of the pivot fulcrum from the lower end of the guide 53 to the upper end of the guide track 52 or conversely, depending on whether the window is being raised or lowered.

Although the foregoing advantages are obtained, the structure is somewhat more expensive to manufacture, as will be readily apparent.

In the embodiment of the invention illustrated in figure 4, the shape of the window and the depth of the window well are such that it is only necessary for the window to be moved rearwardly and then downwardly with only a slight longitudinal tilt being imparted.

As in the previously described embodiments the window panel, herein designated 83 is surrounded by a frame 84 having a lower rail 86. Suspended from the rail 86 is a framework 87 which supports the reversible electric motor 88. The motor 88 is provided with a shaft 89 projecting from both ends thereof.

On the left as viewed in figure 4, the shaft 89 is directly coupled to a reduction gear unit 91. On the right the shaft 89 is coupled to an extension shaft 92 which is coupled to a second reduction gear unit 91. The power output shaft of each reduction gear unit is provided with a pinion, diagrammatically represented as 93 or 94. Each pinion is in mesh with rack teeth (not shown) on a guide track 96 or 97, respectively, the guide tracks also being diagrammatically shown. It will be noted that the guide track 96 is longer than the guide track 97. To compensate for the fact that the pinion 93 must travel a longer distance than pinion 94, the pinion 93 is larger than the pinion 94. Since the gear ratio of both reduction gears 91 are the same, the peripheral speed of the pinion 93 is greater permitting

it to cover more distance per revolution of the motor. In an exemplary structure, the pinion ratio chosen was 1.134 to 1.

In the movement of the panel 83 into the window well, the following occurs: Rotation of the pinions in a clockwise direction causes an initial rearward movement of the window panel to cause the latter to clear the body pillar 98. The window then begins to drop while continuing its rearward movement. The movement pattern may best be visualized by placing a straight edge across corresponding position dots on the two track pattern lines. At about the seventh dot from the bottom, labelled 99, the centre of both pinions will lie on a substantially horizontal line. The remainder of the way down, the centre of pinion 93 will be below the centre of pinion 94 and the rear end of the window panel will be positioned within the window well without interference with the wheel housing 101.

In figure 5 there is illustrated the application of the feature of mounting the power means directly to the support structure of a window panel mounted for straight up and down movement, at least as far as the longitudinal edges of the window well are concerned. In the present embodiment the guide tracks 102 and 103 comprise channel sections provided at one side thereof with vertically extending plate members 104 having the rack teeth 106 thereon. The rack teeth 106 are engaged by equal diameter pinions 107 mounted on the output shafts (not shown) of reduction gear units 108. The reduction gear units are suitably coupled to a reversible motor 109, the latter being securely suspended from the lower rail 111 of the window panel frame 112.

In figure 6, the feature of mounting the power means directly to the lower rail of the window panel frame is shown applied to a window panel adapted to be primarily swung into and out of a window well, the swinging movement being coupled with a slight longitudinal movement. In the present embodiment the transparent panel 113 is shown encompassed by the usual frame 114 having a lower rail 116. At its forward end the lower rail 116 has securely suspended therefrom the motor and reduction gear unit 117. The drive pinion 118 of the motor and reduction gear unit 117 is in engagement with rack teeth 119 carried on the channel-shaped guide track 121. The guide track is sinuously shaped having a reversely curved upper end portion 122 dropping down into a slightly curved centre portion 123 which terminates in a straight lower portion 124. The longitudinal axis of the guide track is tilted rearwardly from top to bottom.

At its rear end the window frame lower rail 116 is coupled by a roller 126 to a short sinuous guide track 127 secured in any convenient manner to the body panel. The guide track 127 is provided at its forward upper end with a short horizontal step 128 which curves into a straight rearwardly descending and inclined portion 129. The portion 129 curves into a further rearwardly extending and upwardly inclined straight portion 131, the angle of inclination of the latter with respect to the horizontal being of minor magnitude.

In operation, rotation of the pinion 118 in a clockwise direction when actuated to move the transparent panel from its figure 6 position to a position within the well, has as its initial effect the raising of the forward end of the panel 113. The next movement is rearwardly and downwardly as the panel is moved over and then down behind the body pillar 132. The roller 126 will drop down the portion 129 of the guide track 127 and then ride up the portion 131 thereof. As the rear end of the panel is following the pattern determined by the roller 126 and guide track 127, the front end of the panel is being dropped into the well. In effect, the panel 113 is being swung in a counterclockwise direction, as viewed in Fig. 6, about the moving pivot centre or axis of the roller 126.

When the window is raised from the well, the movements follow a reverse pattern, as will be readily understood.

The embodiment of figure 7 illustrates the feature of the panel mounted power unit as applied to a transparent panel which is swingable about a fixed pivot. In the present embodiment the transparent panel 133 is illustrated as being mounted in the usual frame 134, which frame is provided with a lower rail portion 136. At its forward end the lower rail portion 136 is provided with a depending leg portion 137 which is pivotally connected at 138 to the vehicle body in a convenient manner.

The motor and reduction gear units 139 and 141, respectively are rigidly suspended from the lower rail section 136. The drive pinion 142 on the reduction gear output shaft is engageable with the rack teeth 143 of a rack plate 144 secured to a channel-shaped guide track, generally designated 146. The guide track 146 is curved to a true radius, the centre of curvature being the pivot point 138.

The housing of the reduction gear unit 141 is provided with a bracket 147 having slide shoes (not visible) engageable with opposite sides of a slideway portion 148 of the guide track to provide lateral stability for the rear end of the transparent panel. This also ensures that the pinion teeth remain in mesh with the rack teeth 143.

In operation, rotation of the pinion 142 in an anti-clockwise direction causes the transparent panel 133 to be swung downwardly about its pivot axis 138; rotation in a clockwise direction causes the panel to be raised.

In all of the embodiments described, the motor and reduction gear unit or units were described as being mounted on a support struc-

ture which either comprised the lower rail of the window panel frame or was integral with or securely attached to the lower rail. The motor and reduction gear unit or units travel with the transparent panel as it is raised or lowered in the window well. The system requires no links, crossed arms or other elements such as are required to transmit movement to the transparent panel with the power supplying unit in a fixed position within the window well.

The advantage of the foregoing when applied to transparent panels which are laterally curved is believed readily apparent. By appropriately placing a lateral bow or curve in each guide track concerned, whether it be the simple straight guide tracks of figure 5, the single arcuately curved guide track of figure 7, or the guide tracks of any of the other embodiments, it is possible to guide a laterally curved window glass or transparent panel into and out of its housing or window well. The lateral bow or curve will, of course, correspond to the curvature of the window glass or transparent panel so that the latter will always be maintained within its guide channels above the belt line, if provided.

With the embodiments of the present invention, it is possible to use compound curvature transparent panels without difficulty. This is particularly so since there need be no concern that there will be any interference with the conventional arms, links or the like utilized in conventional structures.

It will be readily understood that appropriate limit switches and positive mechanical stops will be used with all of the embodiments of the invention illustrated to control the range of movement in an up or down direction.

WHAT WE CLAIM IS:—

1. A window structure for a vehicle body having a window frame with a window opening and a well therebelow, comprising a window panel adapted to be raised and lowered between said window opening and said well, a motor support means secured to said panel at the lower edge thereof, reversible motor means carried on said support means, fixed guide means in said well controlling the path of movement of said panel, said guide means comprising at least one elongated guide track, and connecting means drivingly connecting said motor means to said guide track for moving said panel into and out of said opening.

2. A window structure as claimed in claim 1, in which the guide track is provided with rack teeth and said connecting means comprises a pinion engageable with the said teeth.

3. A window structure as claimed in claim 1 or 2, in which the guide means provide a path of movement which deviates from a straight line as said panel moves between said well and window opening, the curvature of said elongated member permitting said connecting means to remain in operative engagement as said panel is moved into and out of said opening.

4. A window structure as claimed in claim 3, comprising means slidably supporting said motor means on said support structure for movement longitudinally of said panel, said motor means having drive means coupled thereto and in engagement with drive engageable means on said guide track the curvature of said one curved track member permitting said drive means to remain in operative engagement with said drive engageable means as said panel is moved into and out of said opening and as said motor means travels longitudinally therebeneath.

5. A window structure as claimed in claim 4, in which said support structure is provided with a longitudinally extending track member therebeneath, and means slidably attaching said motor means to said track member.

6. A window structure as claimed in claim 1, 2, 3, 4 or 5, in which the guide means comprise at least one guide track located adjacent a longitudinal end of the well and another guide track positioned intermediate the ends of said well, said intermediately positioned guide track being engageable with the motor means.

7. A window structure as claimed in claim 6, in which the guide means comprises a guide track positioned adjacent each longitudinal end of said well.

8. A window structure as claimed in claim 4 or 5 or claim 6 or 7, as dependent on claim 4 or 5, in which the curvature of said one track controls the position of said motor means beneath said panel to provide maximum lift effort on that part of the panel least vertically supported by said guide means during its travel into and out of said well.

9. A window structure as claimed in claim 1 or 2, in which said guide means comprises a curved guide track adjacent each longitudinal end of said well, each guide track being provided with drive engageable means thereon, drive means being coupled to said motor means at each end thereof, said drive means coupling said support structure to said guide tracks and having driving engagement with said drive engageable means, the drive ratio of one of said drive means being greater than the other whereby the one end of said panel travels farther than the other per revolution of said motor means, said curved and said differential rate of travel being effective to provide a movement pattern whereby said window is longitudinally shifted and tilted as it is moved by said motor means between said window opening and said well.

10. A window structure for a motor vehicle,

substantially as described in any one embodiment and illustrated in the accompanying drawings.

MARKS & CLERK.

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Published by The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

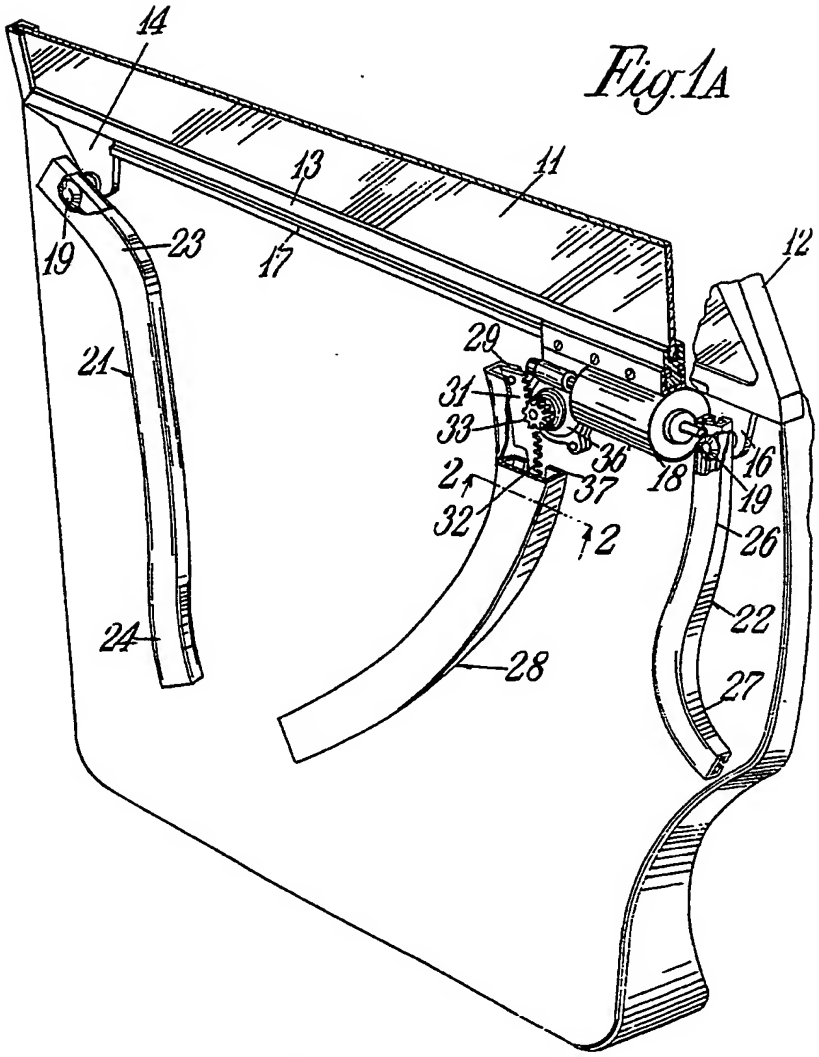

Fig.1A

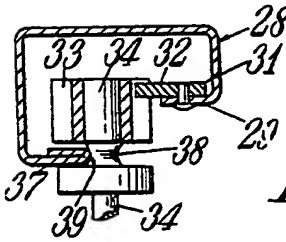

Fig.2

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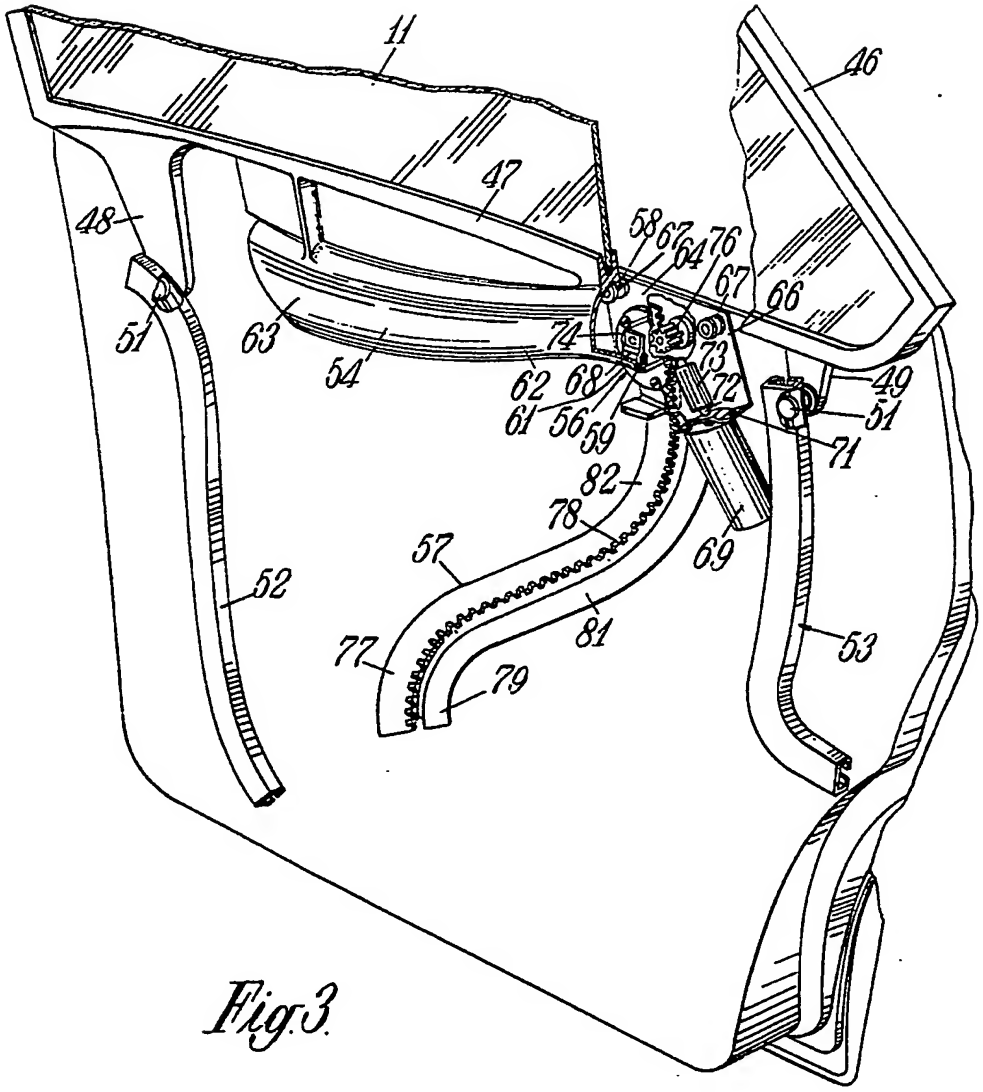

Fig. 3.

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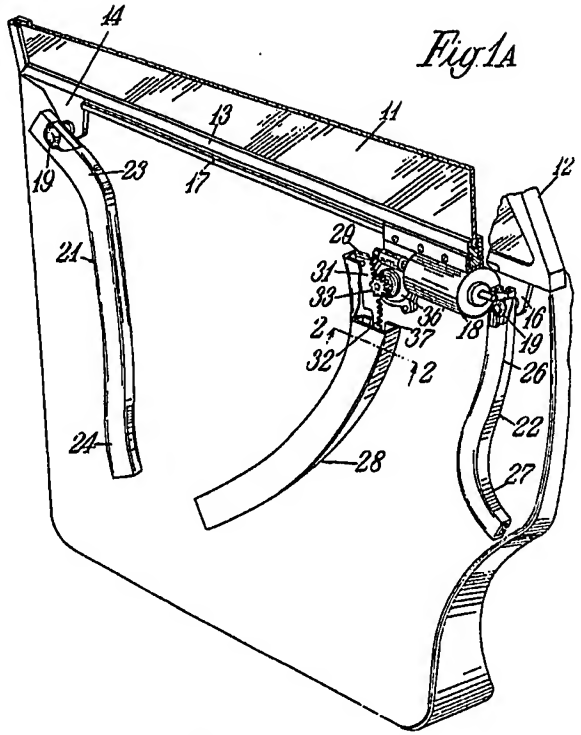


Fig.1A

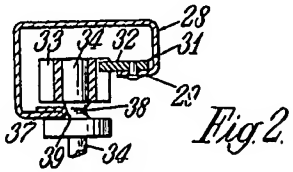


Fig.2

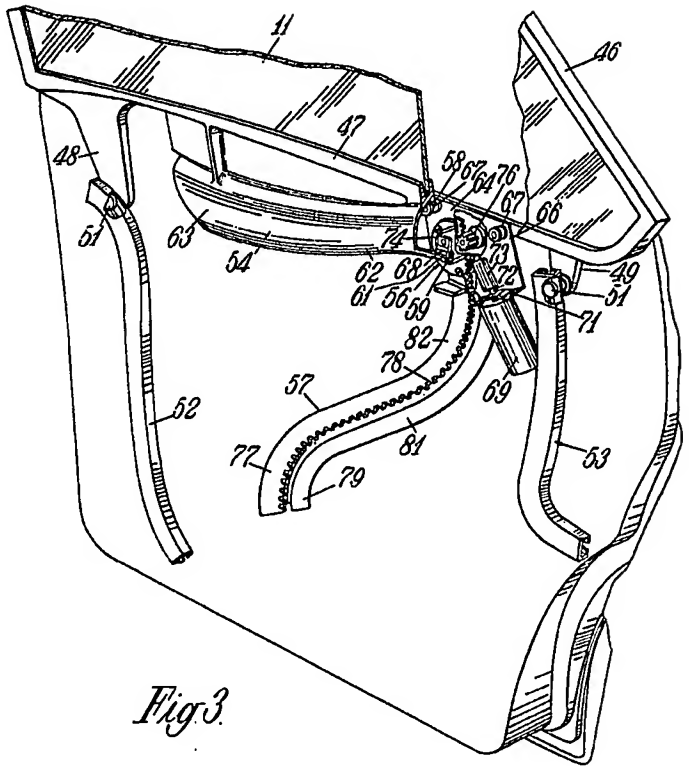


Fig.3

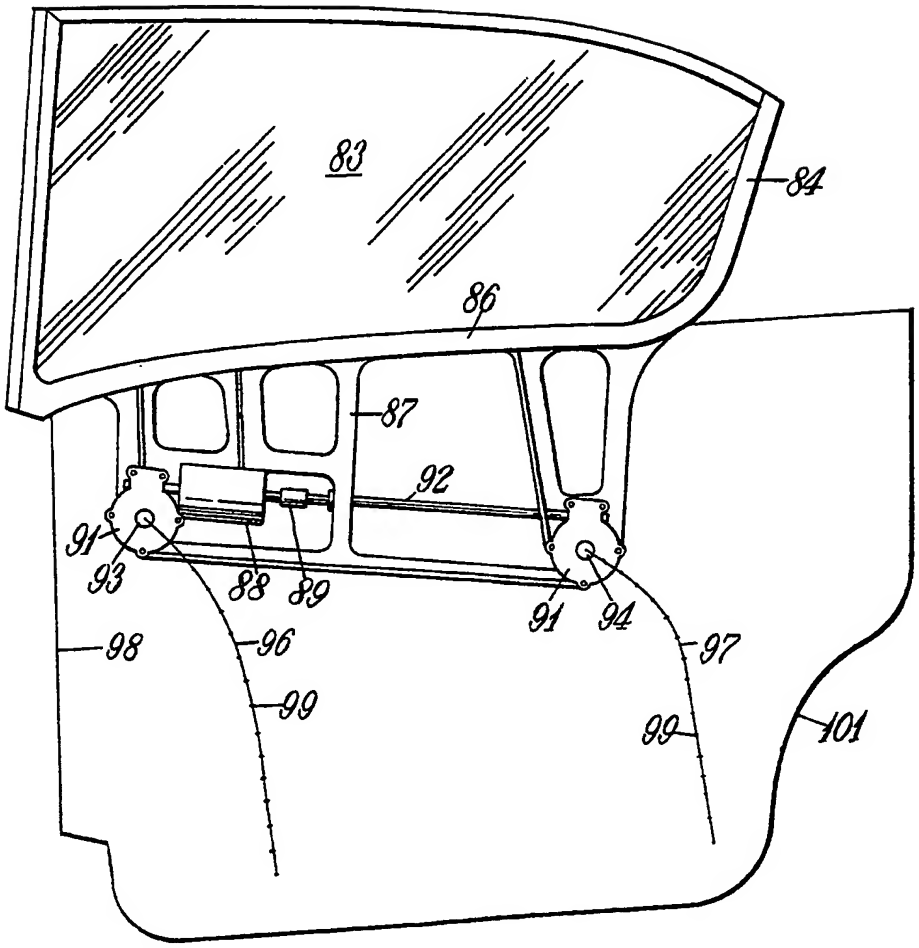
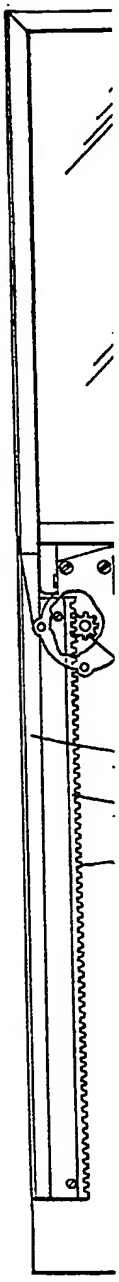


Fig.4



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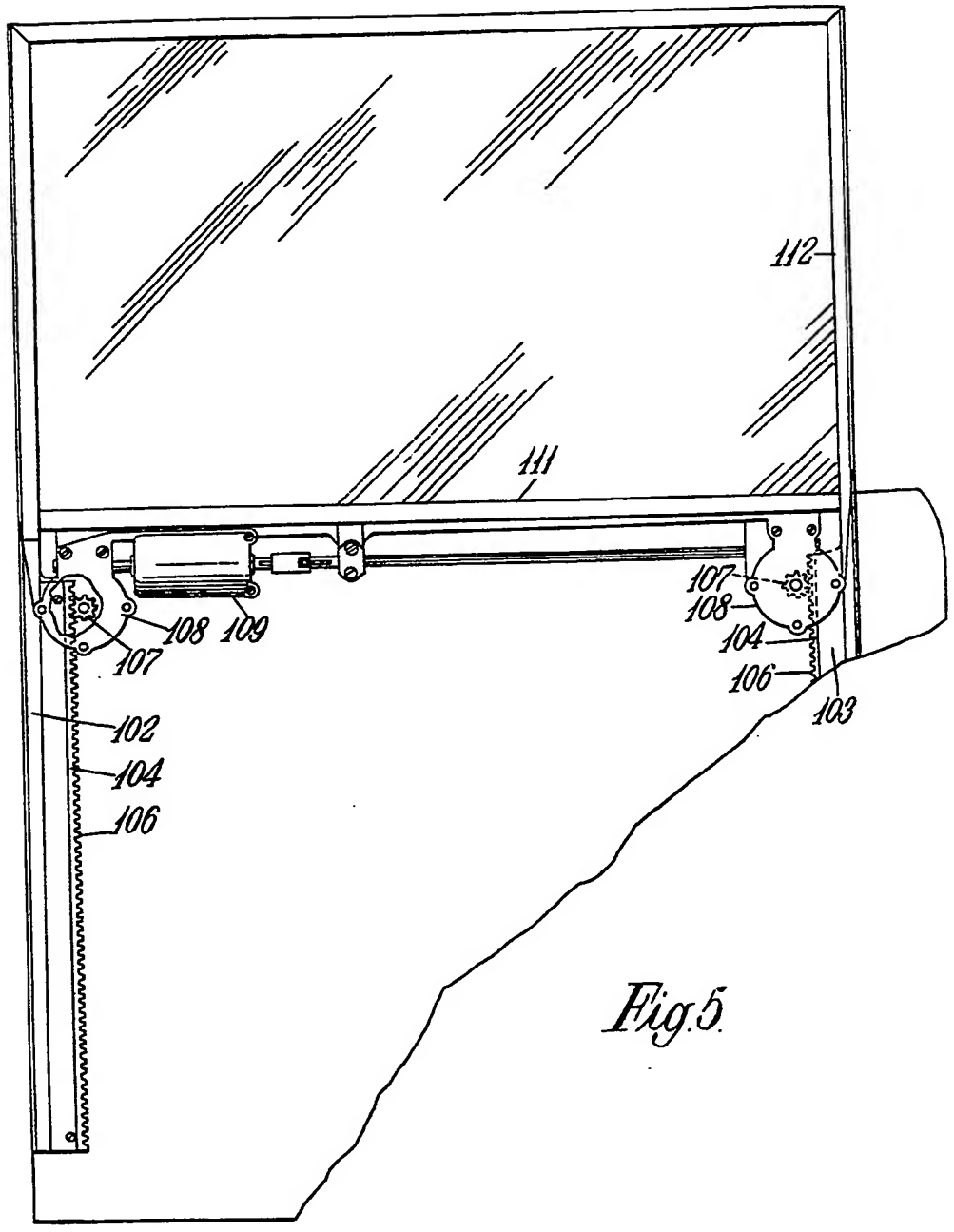

Fig.5.

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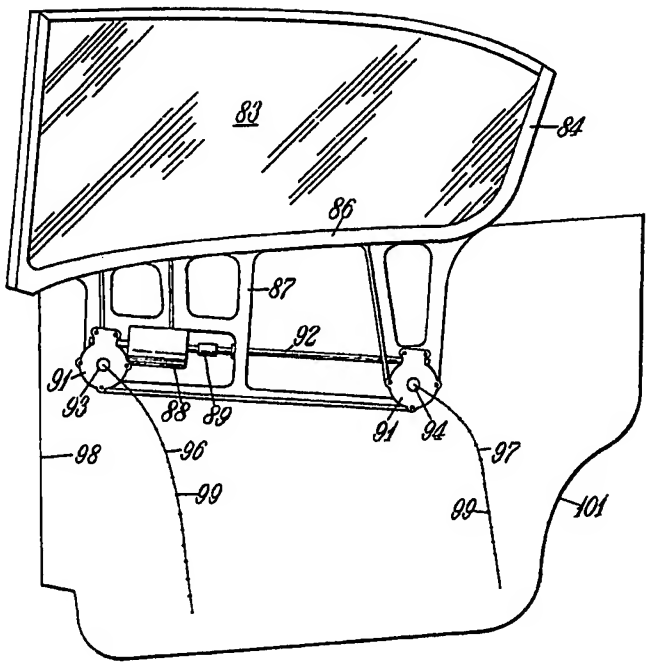

Fig.4

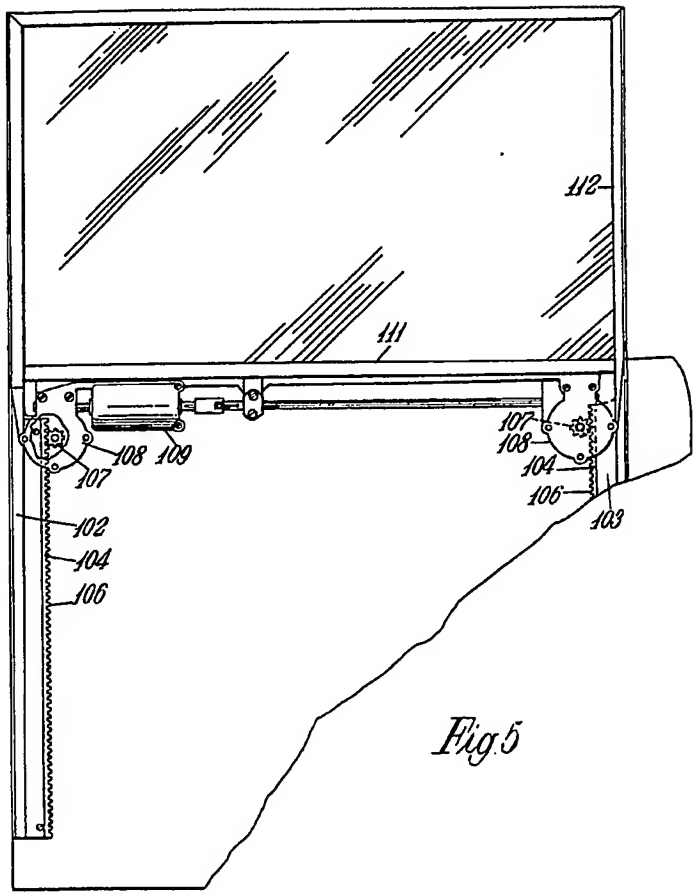

Fig.5

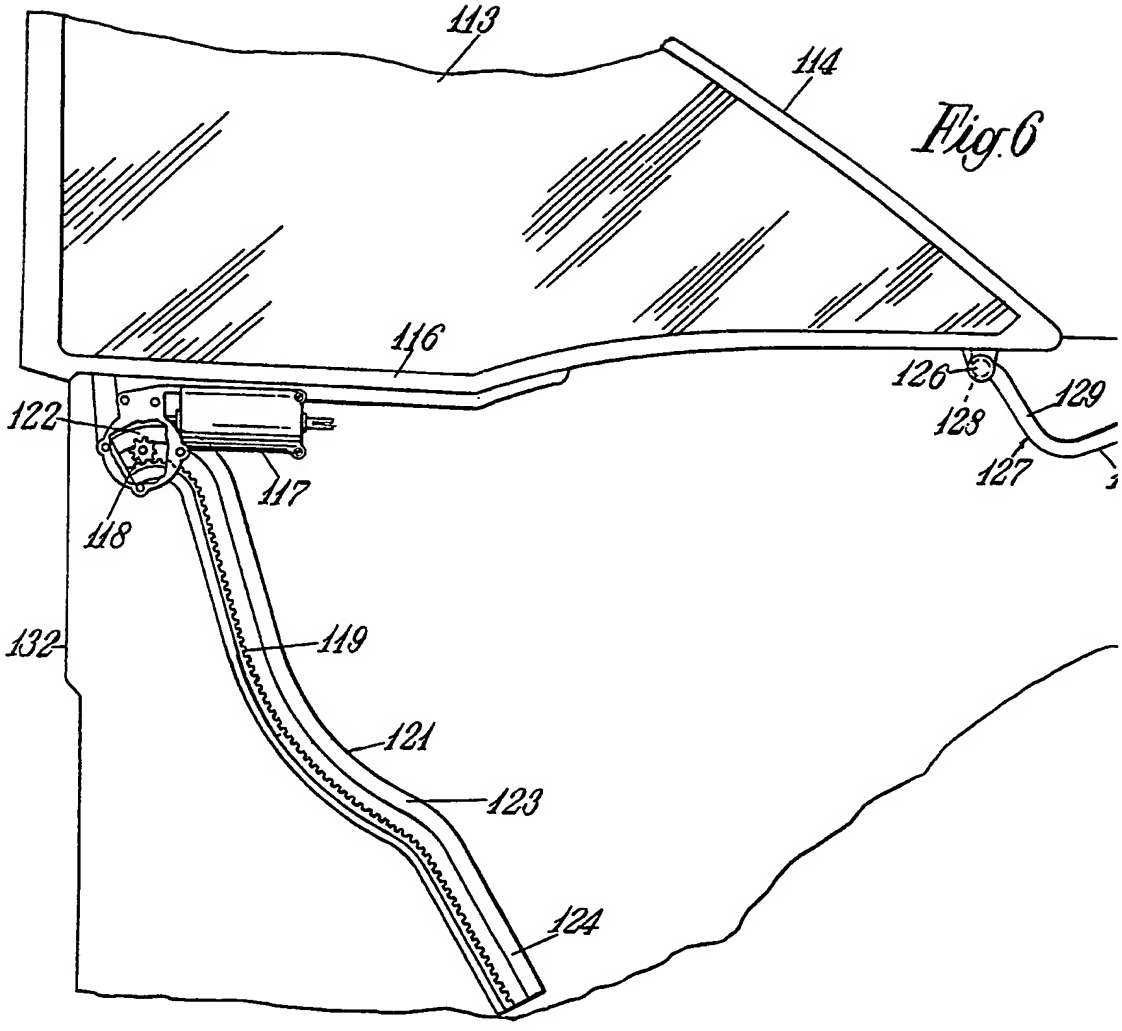

Fig.6

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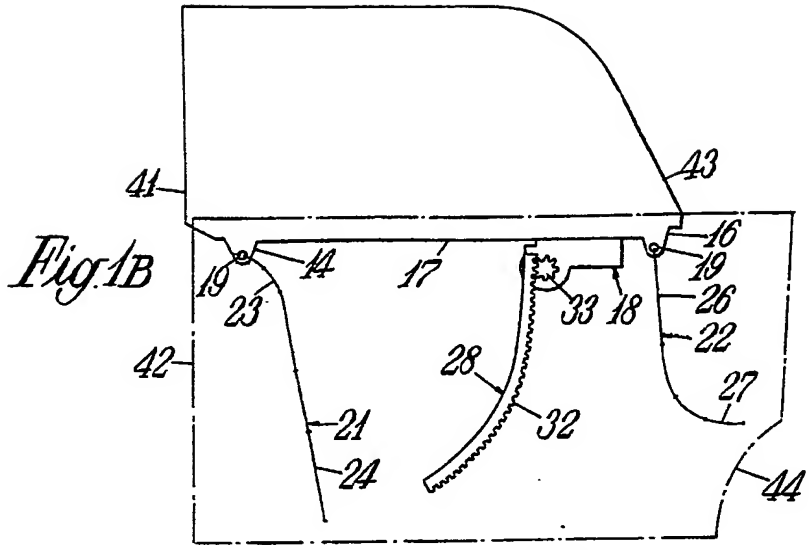

Fig.1B

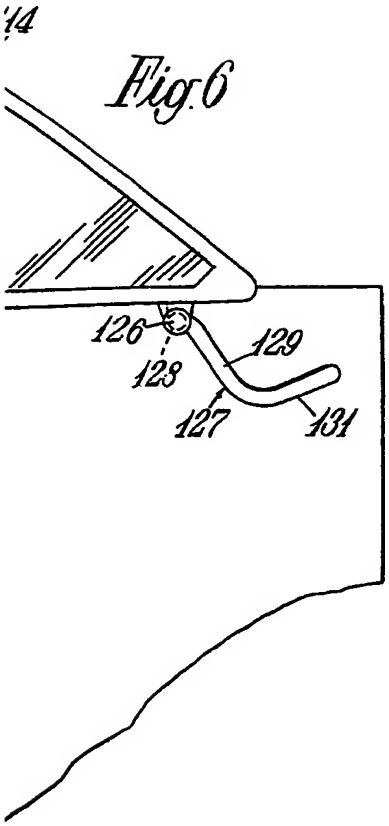

Fig.6

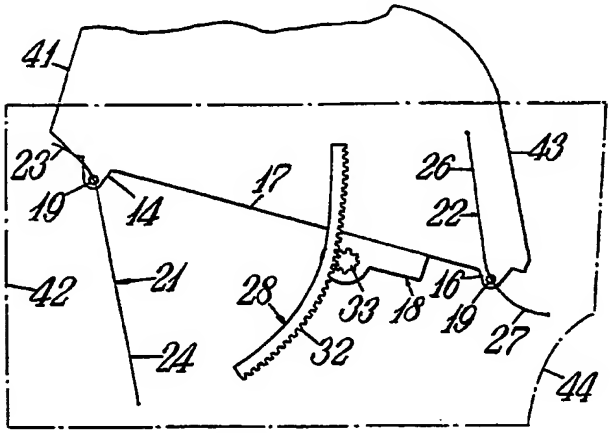

Fig.1C

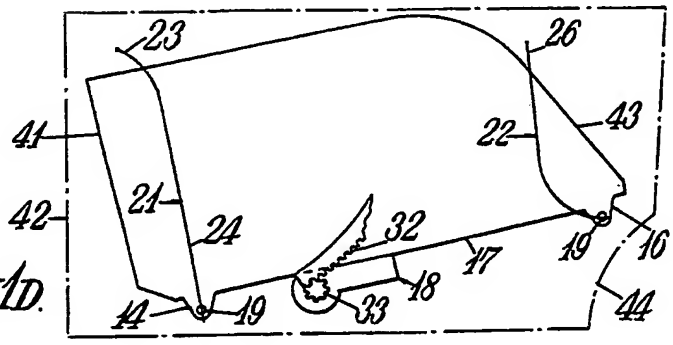

Fig.1D

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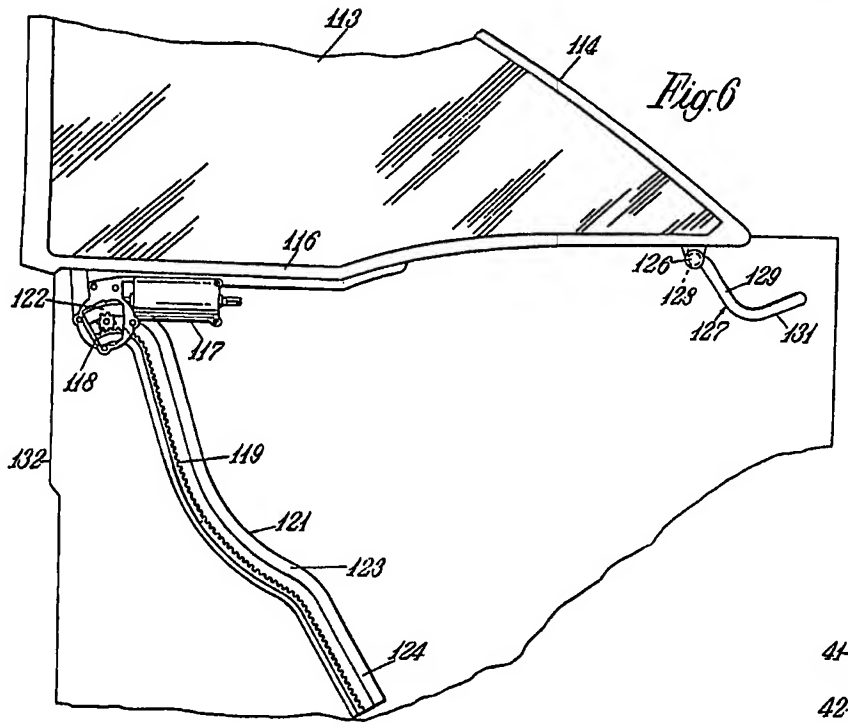

Fig.6

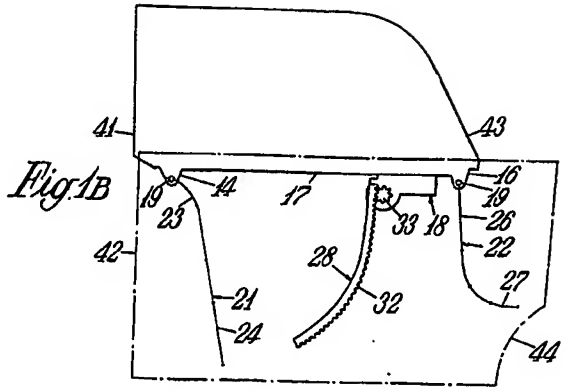

Fig.1B

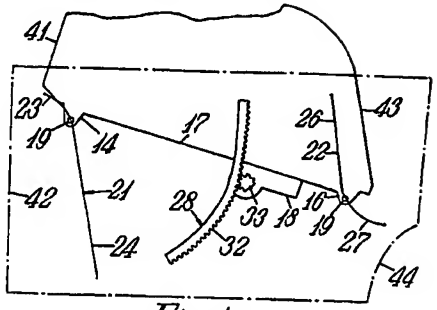

Fig.1C

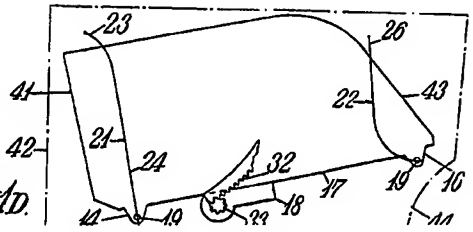

Fig.1D

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6 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale

Sheet 6

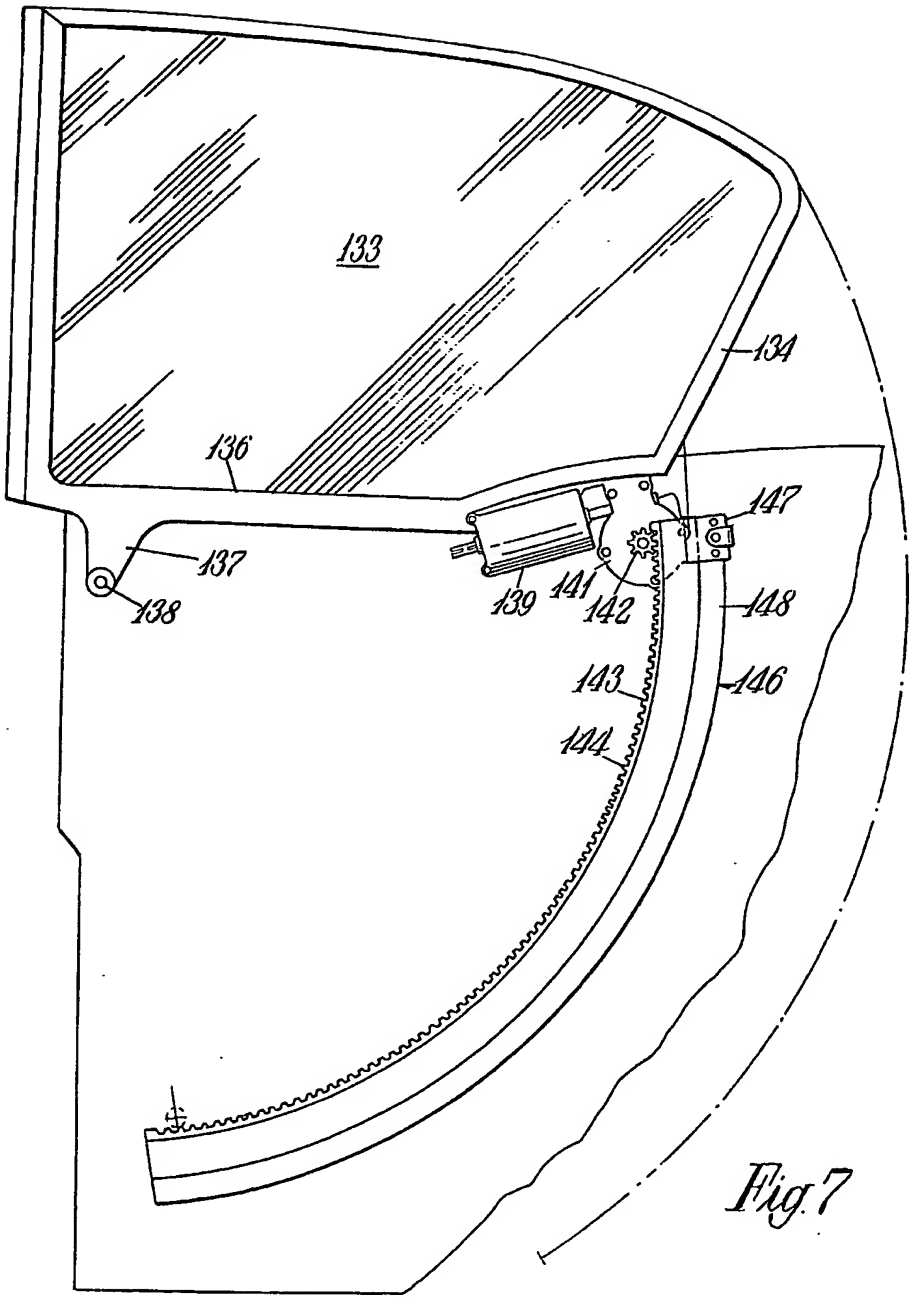

Fig. 7